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EDITOR'S NOTE

We are privileged to publish in this issue the text of a lecture delivered by Dr. Harlan L. Trumbull on 3rd April, 1958, at the Chamber of Commerce Hall, Colombo.

Dr. Trumbull, formerly Director of Colloid Research and Textile Research of The B. F. Goodrich Company and Assistant to the Vice-President—Research, carried on many major Government assignments during the critical rubber emergency of the war. He was Manager of Research and Development for the Office of Rubber Reserve, Reconstruction Finance Corporation in 1946 and in 1947 was designated by the American Chemical Society as one of the ten ablest chemists in the American rubber industry.

Dr. Trumbull has about fifteen major publications and seventeen patents to his name.

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K. D. C. D.

NOTICES

DARTONFIELD GROUP—VISITORS' DAY

Those who wish to visit the Institute are requested to do so after making an appointment. No special days are set apart as Visitors' Days and the services of the technical officers can be availed of for discussion or demonstration only by prior appointment.

PUBLICATIONS

Rubber Research Institute publications comprising Annual Reports, Quarterly Circulars and occasional Bulletins and Advisory Circulars are available without charge to the Proprietors (resident in Ceylon), Superintendents and Local Agents of rubber estates in Ceylon over 30 acres in extent. Advisory Circulars and Smallholdings Leaflets in English or Sinhalese will be available without charge to smallholders on application. Forms of application can be supplied on request.

It will be appreciated if subscribers will return any back publications which are of no use to them.

ADVISORY CIRCULARS

The undernoted Advisory Circulars may be obtained on application at 30 cents per copy. Future issues in the series will be sent free of charge to estates and smallholders registered for the receipt of our publications:—

(5) Straining box for latex (January, 1940).

(12) Warm Air Drying House for Crepe Rubber (Reprinted 1952).

(33) Mechanical Felling of Rubber Trees (Reprinted March, 1955).

(37A) Manuring—Magnesium Deficiencies in Rubber (July, 1954).

(37B) Potassium Deficiencies (September, 1954).

(38) Planting and After-Care of Budded Stumps and Stumped Budgrafts (Superseding Advisory Circular No. 8) (March, 1953).

(39) Clonal Seed as Planting Material (Superseding Advisory Circulars No. 26 and 27) (July, 1953).

(40) Tapping of Hevea Rubber (Superseding Advisory Circulars No. 17 and 34) (June, 1954).

(41) Pink Disease (June, 1954).

(42A) New Local Planting Material for Small Scale Trials on Estates (July, 1955).

(43) Oidium Leaf Disease (Superseding Advisory Circulars No. 22 and 28) (June, 1954).

(44) Diplodia Dieback and Collar Rot of Hevea and Blue Spot of Crepe Rubber (June, 1954).

(47) Ustulina Rot of Rubber Trees (November, 1954).

(49) Root Disease in Replanted Areas (Superseding Advisory Circular No. 31) (October, 1951).

(50) Orange Gall of Hevea (December, 1954).

(51) Bird's Eye Leaf Spot of Hevea (December, 1954).

(52) A Guide to the Cost of Replanting Rubber (December, 1954).

(56) Cover Crops (Superseding Advisory Circular No. 25) (October, 1955).

(57) Notes on Rubber Seedling Nurseries (Superseding Advisory Circular No. 35) (October, 1955).

(58) Notes on Budgrafting Procedure (Superseding Advisory Circular No. 1) (December, 1955).

(59) Manuring of Rubber (Superseding Advisory Circular No. 37) (February, 1956).

(59A) Magnesium Deficiencies. (April, 1957).

(60) Sale of Budwood (Superseding Advisory Circular No. 42) (June, 1958).

(61) Prevention of Coagulation in the Field (Superseding Advisory Circular No. 53) (September, 1958).

(62) The White Root Disease of Hevea—Fomes Lignosus (Superseding Advisory Circular No. 46) (October, 1958).

(63) Brown Root Disease of Hevea—Fomes Noxius (Superseding Advisory Circular No. 48). (December, 1958).

(64) Bark Rot and Canker of Hevea—Phytophthora Palmivora (Superseding Advisory Circular No. 54). (December, 1958).

(65) The Phytophthora Leaf Disease of Hevea—Phytophthora Palmivora (Superseding Advisory Circular No. 45). (December, 1958).

THE DEVELOPMENT AND USE OF SYNTHETIC RUBBER IN THE U.S.A.

By

Harlan L. Trumbull

When the oral invitation of Dr. Baptiste to talk in Colombo was given me in November, 1957, at the B. F. Goodrich Research Center in Brecksville, Ohio, it was agreed that my remarks would cover the development, production, and use of synthetic rubber in the U.S.A. But, as the Director has recently chosen to have the talk presented before a larger group than the Board of Directors of the Rubber Research Institute of Ceylon, the scope of the subject matter has been enlarged to include mention of certain researches as the foundation stones upon which a new industry has been designed and built.

Prelude.—Michael Faraday, the pioneer scientist and progenitor of the electrical industry, made an analysis of "India rubber" in 1826 at the request of his friend Thomas Hancock, pioneer of the rubber industry in England. This noteworthy analysis of Faraday established rubber as a hydrocarbon $(C_5H_8)\times$.

Interlude.—William Tilden, teacher of organic chemistry, reviewing earlier work by French and German scientists became convinced (1882-1886) that isoprene C_5H_8, boiling at 30°C was the molecular unit from which the chemist could make rubber. He pried into this corner of the unknown on a test-tube scale, was rewarded when specimens of isoprene set aside in a well-lighted place were observed to have changed to a solid jelly with properties resembling rubber. He let his observations be known in lectures and in papers. It was a subject that was soon to be involved in international jealousy between scientists in France, Germany and England, each group trying to establish priority for its own nationals in the realm of discovery of "synthetic" rubber, a quest in which not a single one of these scientists proved to be successful.

Before 1914 two companies working in the U.S.A. (Hood Rubber Company, Watertown, Massachusetts, and Diamond Rubber Company, Akron, Ohio) made and built articles of synthetic rubbers derived from isoprene, butadiene and dimethylbutadiene, and the I. G. Farben, Germany, had tires made and cured from a rubber of the dimethylbutadiene type derived from acetone. None of these ventures were commercial successes, and they served mainly to emphasize that in research, as in love, the true path never runs smooth.

Interval between World Wars.—Dr. Duisberg, I. G. Farben founder, with unsupported pride in German progress, had the Kaiser's car equipped with tires of W rubber (based upon acetone). The idea of making W rubber compete with natural rubber proved fantastic and was abandoned, but Dr. Duisberg, with indomitable belief in German superiority, in 1924 organized anew the search by the I. G. scientists for a workable synthetic rubber, a quest that led later to the Buna rubbers.

It was also in 1924 that the Du Pont Company started research in the U.S.A. toward a synthesis of rubber with an appropriation of a half million dollars to support it.

In 1926, The B. F. Goodrich Company employed Dr. Waldo Semon, a research scientist to hunt systematically for a novel method of making chemical rubbers.

During the decade 1930-40 these three independent projects succeeded in producing new chemical rubbers and in developing their syntheses past the pilot plant stage into commercial production.

Du Pont's Neoprene, a polymer of 2-chlor-butadiene was the first diene synthetic rubber stemming from these post-War I researches to be made commercially. Acetylene and hydrochloric acid are the source materials. Wallace Carothers of Nylon fame was one of the inventors of Neoprene.

The Buna Rubbers and Ameripol.—The studies in Germany by I. G. Farben and those in Akron by B. F. Goodrich originated copolymers that were made by joining simpler chemicals (monomers) in a water emulsion. The resulting latex had to be coagulated with significant deviations from the steps followed in natural latex coagulation to yield the solid form of synthetic rubber. The formation of a latex from a water emulsion of chemicals gave marked chemical engineering advantages over previous methods, *viz.* the handling of liquids with proportioning pumps and meters, the precise control of temperature, and the maintenance of a delicate heat balance since the rubber formation is a heat-producing step, and unless heat is bled off the product is inferior.

The predominant monomer used (usually 70-75%) to make general purpose rubber was butadiene. The choice of secondary monomers and the control of operating conditions determined the types of synthetic rubber produced. In Germany the "lettered" Bunas, Buna N, Buna S, etc. and Perbunan were sold by the I. G. Farben to the rubber consumers to be fabricated into articles. In Akron 1940, synthetic rubber appeared dramatically on the market as the "Ameripol" tire, all of the steps in both synthesis and article manufacture being performed within The B. F. Goodrich Company.

The key chemicals involved in the synthesis of rubber are the dienes. Charted by formulas, they are these:

$CH_2=CH\text{-}CH=CH_2$.	Butadiene.
$CH_2=C(CH_3)\text{-}CH=CH_2$.	Isoprene, 2-methylbutadiene.
$CH_2=C(Cl)\text{-}CH=CH_2$.	Chloroprene, 2-chlor-butadiene.

These compounds are all diolefines which is another way of saying they contain at least four carbon atoms, and the same arrangement of double

$$\begin{matrix} C=C\text{-}C=C \\ 1\ \ 2\ \ 3\ \ 4 \end{matrix}$$

bonds, which to the chemist indicates (1) the possibility of this molecule reacting in at least four different ways, and (2) the release of a definite quantity of energy

as heat for each type of reaction initiated. Of the four types of reaction possible (neglecting others as less probable), one is preferred and the other three are to be avoided if possible. The properties of the resulting rubbers depend on how well the chemists and chemical engineers have been able to divert the chemical step (polymer formation) into the precise path that it should follow. Fortunately, researches have cleared up most of the obscurities which formerly surrounded the polymer forming step so that scientists and engineers can set up and adhere to rigid specifications of both process and product.

Isoprene, which Tilden had favored as the source of a chemical rubber, is not readily or cheaply available even in the modern chemical industry, although petroleum can be made to furnish isoprene by off-beat methods of manufacture. Chloroprene is the product of a special chemical reaction not likely to be in demand for purposes other than making Neoprene. Its cost, like that of isoprene, seemed destined to be fairly high. But butadiene of high purity at low cost can be made abundantly by fractional purification from cracked petroleum. Hence, butadiene became the preferred member of the diene family for rubber synthesis.

Butyl Rubber.— In 1940 the Standard Oil Company of New Jersey announced the discovery of Butyl rubber, properly termed a petroleum rubber since over 95% of its weight is derived from isobutylene, a cracked petroleum fraction, and less than 5% from isoprene. This, depicted in broad strokes and with minor omissions, is the status of synthetic rubber research and development at the time the Japanese invaded South-East Asia and cut off 90% or more of the world's natural rubber.

The Standard Oil Company of New Jersey had acquired from Germany the right to license others to make the Buna rubbers developed by I. G. Farben. By 1942 at least two of the large rubber companies had small plants erected to make Buna rubber. Together with the Du Pont plant to make Neoprene and the B. F. Goodrich plant to make the Ameripol and the Hycar-type synthetic rubbers, the total capacity of the country was limited to a production of only a few thousand long tons a year of synthetic rubber.

The individual companies who faced the need to manufacture synthetic rubber after the start of World War II were unable to command enough capital to do the whole job. Congress was asked to empower the Government to build large plants in the interest of national security. The officials appointed to formulate plans could not decide just how large the plants should be. After a lapse of two years with nothing done, the Japanese blew up Pearl Harbor and invaded South-East Asia.

Magnitude of the Problem after Pearl Harbor.—

(1) The rubber requirements of the U.S.A. and her allies were ca. a million tons a year.

(2) The raw materials for synthetic rubber had to come from sources in great demand for other purposes in the war period; for example, aviation fuels, foodstuffs, etc.

(3) The course followed had to equip the country, although at war, with both Germany and Japan, to make the rubber and to convert it by mass production methods into fabricated articles at a rate double that of any period in the previous decade.

(4) The work of the Baruch Committee, consisting of two scientists and a philanthropist, gave us the blueprint and the schedule that had to be followed. The plan which proved workable within the dates set by the committee included:

(*a*) The appointment of a "rubber czar," initially William Jeffers, served to mobilize the brains and the vast resources needed to get on with the job.

(*b*) The immediate increase of facilities for making reclaimed rubber which helped a great deal, especially during the first year of rubber famine.

(5) Congress empowered the Government to build and run 52 plants which cost over $700 million to make GR-S (Government rubber-styrene type), butyl, Neoprene, and minimal amounts of rubber of other types. By the end of 1943 all plants were operating. A million tons of rubber were made in 1945.

(6) Technical information from all sources were pooled under the "rubber czar" and extensive research studies were organized, *de novo,* under Government direction to support the project and to anticipate improvements. Improvements in both process and product were not slow in coming and continued steadily.

(7) Government spent up to $5 million a year on research and brought scientists from universities, from industry, and from research institutes to apply joint efforts to the problems.

(8) Patents were pooled for the duration of the emergency under orderly provisions set up promptly by Government agencies.

It would have been very easy in 1943 to take a pessimistic view of the whole program of Government rubber, with three-fourths of a billion dollars spent, and the copolymer plants turning out increasing tonnages of a product that the rubber technologists did not know how to use. Fortunately, the pessimism concerning our efforts in America was confined to Germany where their rubber scientists assured the Wehrmacht that our efforts were doomed to disaster, and the Baruch plan could not possibly be made to work. After all, the composition of the Baruch Committee with two college presidents and a philanthropist lent some credence to this viewpoint.

However, in our country there was no occasion for gloom. We recognized the competence of Dr. Conant and Dr. Compton as trained research investigators who had consulted the best sources of information and had omitted no detail in their study. We knew that as they had planned our work and scheduled the goals precisely, that we had to work the plan and meet the deadlines set.

Interlude on Latex.—Mention has been made of the emulsion process synthetic rubbers (GR-S, Buna S, Buna N, the Hycars, etc.) in which the rubber is derived in the form of a latex. Significant is the small size of the latex globules in these copolymer rubbers (less than one-tenth the diameter of the particles in natural latex). Adsorbed on the surface of the fine synthetic rubber particles are non-rubber ingredients (soap predominantly) in much higher amounts than in Hevea latex. These impurities occasioned special problems in handling the latex and standardizing the quality of the rubber in the Government plants.

Now, if you will pardon a digression, there are a few personal observations that I should like to make pertaining to best methods of conducting researches. The best way to solve difficult problems is to have gifted scientists who have made

fundamental studies long enough ahead of time to be prepared for the challenge when it becomes necessary to meet it. "Then," to quote Milton, "if virtue feeble were, Heaven itself would stoop to her."

The B. F. Goodrich Company after 1926 had a continuous interest in rubber latex. After 1933 they maintained the Malayan research laboratory at Kuala Lumpur under Edwin Newton to study rubber at the source. Incidentally, Edwin Newton helped develop the Anode Process for making articles from natural latex and it is not without point that he was a pioneer in the emulsion polymer field of the vinyls.

Associated with Mr. Newton at Kuala Lumpur were Edward Willson, colloidal chemist, and W. D. Stewart, biochemist. It is not the purpose of this discussion to relate the story of the Malayan adventures of these research men beyond mention of their acquaintance with rubber at the tree, a curious admixture of hydrocarbon, protein, enzymes, catalases, sugars and mineral impurities. But based on the plantation speaking acquaintance with Hevea, Willson and Stewart were destined to make strategic contributions to the synthetic rubber program in the U.S.A. Willson's work related to cleaning up the impurities on the minute synthetic latex particles, and it was done promptly and unobtrusively in the shakedown runs of the polymer plants. It would be oversimplification to say that if you want to remove salts, more salt should be added, but in actual operation it seemed almost that simple.

The invention of cold rubber by W. D. Stewart was suggested by his knowledge of tree rubber, where the rubber never exceeds 38°C in temperature. Stewart was prompted to look for catalysts that functioned in synthesis more nearly like enzymes in living systems. "Cold rubber" patents, the property of The B. F. Goodrich Company turned over to the Government in wartime, were the basis on which millions of tons of "cold rubber" were made in the GR-S plants. Cold rubber gave advantages over GR-S in both the uncured and cured state. It was the sustained extra effort of talented research scientists like those just mentioned that made the synthetic rubber produced a little better than seemed necessary.

The Use of Synthetic Rubber.—Now we come to the little known and unheralded story, the use of synthetic rubber. GR-S, the main purpose Government rubber which issued in volume from these polymer plants, was a commodity unknown to 95% of the factory compounders in 1943. It seemed not at all suitable to serve as a basis for military and civilian goods needed to win the war.

GR-S had poor building tack. It took more time on the mill. The batches did not knit well together. The building plies required cementing. The union with tire cords upon curing was defective. GR-S carried more fatty acids initially than crude rubber, so the helpful addition of more stearic acid or lauric acid, as in previous practice, to effect cure was not permitted. It took only two-thirds as much sulfur as natural rubber had required and all recipes, all mixing specifications, all building instructions, and all curing procedures had to be revised promptly and in the face of inadequate information. As if the devil himself had a hand in it, it was mandatory in the same period to swing over the cords of 90% of the tires from cotton to high tenacity rayon. It was found unsound to blend synthetic with natural rubber, so the crippled compounder could not limp along on that crutch. He had to solve one after another of these burdensome problems with little help from anyone. So, that is what he did !

It was soon discovered that the handling of GR-S stocks in internal mixers operated at higher temperatures with 20% more material and at speeds a third

higher than for natural rubber batches gave stocks that handled well. Resorcinol-formaldehyde latex treatment of the cords gave uniform bonding. The cleanliness of the rubber in the bale led to fewer carcass defects, and the tread wear of tires with GR-S was brought to a level as good as or better than with natural rubber. A structural carbon black later originated by the petroleum companies bettered tread wear by another 15%.

In the manufacture of rubber articles during World War II, there was voluntary exchange of technical information between rubber manufacturers. This exchange was promoted by technologists appointed by the rubber czar, but not even the rubber czar had the authority to order this action by the competing rubber companies. The voluntary exchange basis proved highly effective as an educational step to all parties involved.

Patents and research information in the field of synthetic rubber manufacture were made available to the Government under separate contracts with those who supplied the starting hydrocarbons (the petroleum industry) and with those who operated the rubber plants (the rubber industry). These contracts had dates of termination which were scrupulously observed. All the plants have been sold back to private business after roughly a dozen years' operation by the Government, in which profit was earned, $50 million in one year. The sale netted the Government 96.3% of the fair evaluation set upon these plants in 1955. The fair valuation was about half-way between the book value of the plants fully depreciated, and that value without any depreciation.

The use of general purpose synthetic rubber over fifteen years in our country and its acceptance on a quality basis make it probable that we shall never base as much as 50% of our nation's rubber requirements on natural rubber, even with a constantly increasing demand for natural rubber. Especially in the form of latex, this demand promises to be brisk.

Natural rubber, regardless of origin, is destined in the future to compete with butadiene rubbers. Butadiene stripped out of cracked petroleum is the basic economic unit of general purpose rubbers made by synthesis. A fair average price for butadiene of 12 cents a pound enables the producer of GR-S to sell this rubber at 24 cents. Some day, it is reasonable to expect that cheaper hydrocarbons than butadienes may be fashioned into rubbers that will undersell those derived from butadiene.

Research has recently been able to duplicate the molecule of natural rubber by starting with isoprene and reacting it with contact catalysts. It is the identical molecule that nature produces in at least two thousand living plants, but in no instance more effectively than in Hevea Brasiliensis. The laboratory product is a bit cleaner than natural rubber and free from non-rubber impurities. But it seems reasonable to suppose that it will always be higher in price than the rubbers based upon butadiene, and perhaps in the price range of Neoprene. Scientists place this discovery in the front rank of chemical achievements. As a citizen of a country which has consistently supported the United Nations, I hail this achievement as having removed one more possible threat to world peace. The world can never again be cut off by military occupation from 93% of its supply of rubber as a raw material.

To you in Ceylon who are interested in the future growth and health of rubber production, I congratulate you upon your faith in and support of research. Whatever course the rubber growers may face in the future, there can be no question

that the results of scientific studies will give the information that you need to solve your problems. There is no royal road to success, no crystal ball gazers, no advertising ballyhoo artist who can benefit you. Place your trust in the truth and in scientific inquiry which invariably leads to it.

ANTIMUCIN—A NEW WATER MISCIBLE FUNGICIDE FOR THE CONTROL OF BLACK STRIPE

By

Alfred Riggenbach

Introduction :

The incidence of the bark rot or black stripe disease of the rubber tree (Hevea brasiliensis) caused by Phytophthora palmivora has considerably increased in recent years, and has become in many districts an economically serious affliction of the tapping panel ; badly affected trees have to be taken out of tapping for considerable periods. The greater activity of the disease in recent years is undoubtedly the result of denser and better canopies and the parallel increased development of the Phytophthora leaf disease. The most susceptible clones are PR 107, Wag 6278, MK 3/2 and PB 86.

As a result of the considerable economic importance which must now be attached to bark rot, all the commonly used fungicides as well as some new fungicides were carefully tested with regard to their fungicidal efficacy against Phytophthora palmivora. These investigations became particularly necessary when it was found that a number of products in wide use did not satisfactorily prevent or cure the disease, despite regular applications. This was subsequently confirmed in careful laboratory and field experiments.

Testing Methods:

In the laboratory two groups of tests were carried out, and each test was replicated at least three times to preclude any possible errors.

In the first group the various fungicides were admixed in carefully measured quantities to the growth medium, Corn Meal Agar, which was then inoculated with a piece of a pure culture of the fungus Phytophthora palmivora, isolated previously from a bark rot lesion. The petri dishes were then kept at constant optimal growth temperature, and the growth rate of the fungus measured after 2, 4, 6 and 8 days. The better the fungicide the smaller the rate of growth or, at best, complete inhibition of growth.

In the second group the fungus, Phytophthora palmivora, was allowed to grow on the same artificial medium in petri dishes from the centre towards filter paper discs impregnated with a given concentration of fungicide. If the fungicide is at all effective, a growth inhibition is formed around this paper disc, and the degree of effectiveness is determined by the radius of this circle. With maximum inhibition, *i.e.* effectiveness, the fungus does not grow towards the treated filter disc at all ; on the other hand, if the fungicide is entirely ineffective, the fungus will even grow over the treated filter paper disc.

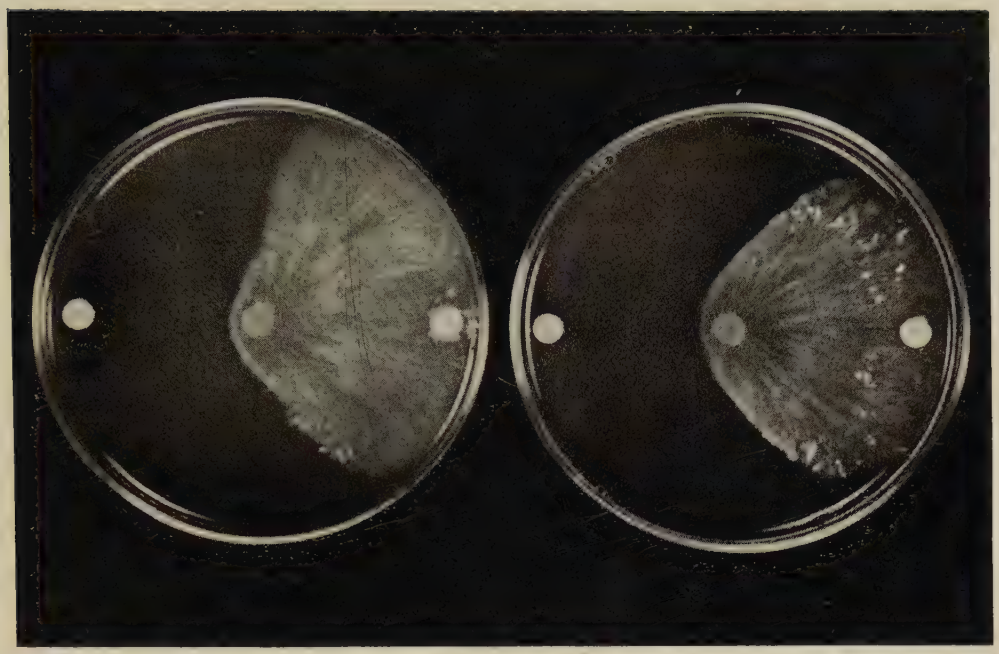

DIAGRAM A.

Left Petri dish: Left disc: Antimucin solution (0.1% active material) inhibits growth of Phytophthora palmivora completely.

Right disc: Izal solution (1% commercial material) has no inhibiting effect on growth of Phytophthora palmivora.

Right Petri dish: Left disc: Antimucin solution (0.1% active material) inhibits growth of Phytophthora palmivora completely.

Right disc: Brunolinum Plantarium (1% commercial material) has practically no inhibiting effect on growth of Phytophthora palmivora.

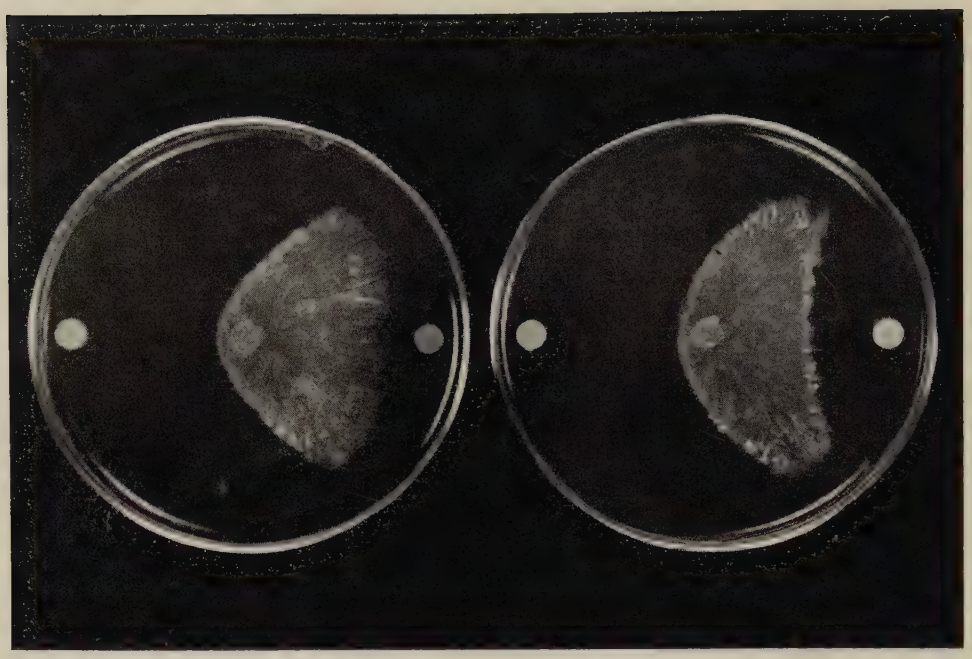

DIAGRAM B.

Left Petri dish : Left disc : Antimucin solution (0.1% active material) inhibits growth of Phytophthora palmivora completely.

Right disc : Fylomac 90 solution (1% active material) has only slight inhibiting effect on the growth of Phytophthora palmivora.

Right Petri dish : Left disc : Antimucin solution (0.1% active material) inhibits growth of Phytophthora palmivora completely.

Right disc : Captan solution (1% active material) has only slight inhibiting effect on the growth of Phytophthora palmivora.

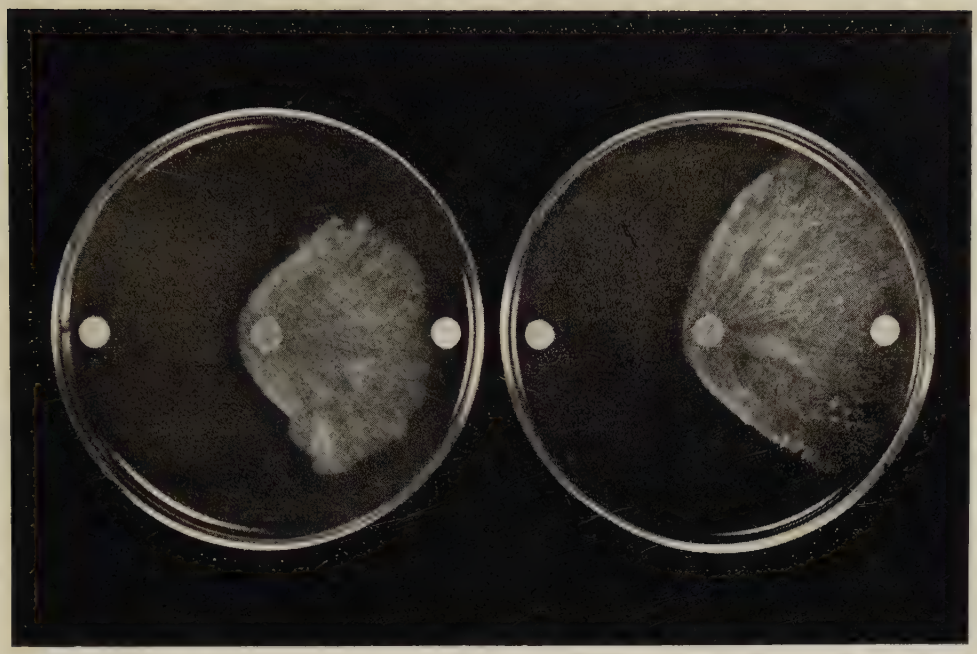

DIAGRAM C.

Left Petri dish: Left disc: Antimucin solution (0.1% active material) inhibits the growth of Phytophthora palmivora completely.

Right disc: Penta-chloro-nitro-benzol solution (1% active material) has practically no inhibiting effect on the growth of Phytophthora palmivora.

Right Petri dish: Left disc: Antimucin solution (0.1% active material) inhibits the growth of Phytophthora palmivora completely.

Right disc: Antiphy (1% active material) has no inhibiting effect on the growth of Phytophthora palmivora.

A great number of sulphur, copper, mercury and carbamate fungicides, as well as Anti-phy, Brunolinum plantarium, Captan, Fylomac 90, Izal, Karathane, penta-chloro-nitrophenol and Thiuram were tested.

Results :

In all these numerous tests, the mercury-based fungicide, Antimucin, proved to have by far the greatest fungicidal effectiveness against Phytophthora palmivora. Tillex, another mercury-based fungicide, was equally effective, but this product is less suited for the treatment of tapping panels. Considerably less but still fairly effective were copper sulphate and copper-based fungicides, which because of the danger of contaminating latex cannot, however, be recommended for use on tapping panels. Fylomac 90 and Captan were about as effective as copper fungicides. Practically ineffective are Anti-phy, Brunolinum plantarium, Izal, Karathane, Thiuram, and the sulphur-based fungicides.

In special tests, the more promising products were found to be non-phytotoxic in the concentrations in which they are to be used.

Field experiments have confirmed the above laboratory findings, and in large-scale use against panel diseases Antimucin has proved to be extremely effective.

The results show that of all the currently available fungicides used in these tests Antimucin is the product of choice for bark rot control in Hevea. The product as compounded has, furthermore, cellulose-fixing properties which prevent it from being washed off by rain. In the very low concentrations required for effective disease control in the field, Antimucin is also most economical and is practically harmless in use.

Suggestions for Practical Use :

Antimucin, which is a liquid, should be used in concentrations of approximately 1 : 160 (1 fl. oz. in 1 gallon of water) to 1 : 320 (1 fl. oz. in 2 gallons of water) depending on the severity of the disease on individual estates, and on weather conditions. The material is best brushed on the panel immediately above the tapping cut at each tapping, prior to tearing off the scrap. When the danger of infection is less pronounced, application may be made at every second or third tapping only. In addition, it may be advisable to spray the panels once a month during the Phytophthora season. Cleaned out canker patches may also be brushed over with Antimucin solution prior to application of a sealing compound.

For further details reference should be made to R.R.I.C. Advisory Circular No. 64.

"CABOOK" OR LATERITE IN RELATION TO THE SOIL SURVEY OF THE RUBBER GROWING DISTRICTS

By

A. J. Jeevaratnam

Introduction.

The manurial requirements of any crop are known to vary according to the different soil types on which it is grown. And Hevea is no exception to this. With a view to assess the manurial requirements of rubber, several field manurial trials have been laid down by the Rubber Research Institute in different rubber growing districts of Ceylon. In conjunction with this, a programme of soil survey was initiated to find out to what extent the findings of these field trials can be applied to a particular district or districts, on the basis of soil similarity.

In the course of this soil survey, various soil types have been encountered which have been grouped together as *lateritic* soils.

This paper attempts to answer the leading questions on the controversial subject of laterite as far as soil scientists are concerned :

What is laterite ?

Can local *cabook* be called laterite ?

Is the use of the adjective justified in describing a soil ?

The paper was read at the thirteenth annual sessions of the Ceylon Association for the Advancement of Science. It is reproduced here with a view to enlightening the planting public of Ceylon as to what they mean when they describe a soil as laterite or lateritic.

Cabook.

Cabook is the Sinhalese name for a mottled deep red, yellow or reddish brown, ferruginous material showing vesicular structure. It has the peculiar property of being soft when newly quarried but becomes hard and compact on exposure to air. Material similar to *cabook* has been used for building purposes in other tropical countries *e.g.* Malaya, Siam and India.

In Ceylon it has been stated that *cabook* occurs chiefly in the low country wet zone, on the Western coast from Negombo to Matara, and for some distance inland. According to Joachim (1) *cabook* in Ceylon is found where the igneous rock charnockite occurs in a region with an annual rainfall of over 100" per annum with dry intervals.

Cabook is quarried up to various depths, sometimes as much as 30-40 ft., and occasionally deeper. The surface of these pits is sometimes mantled with concretionary gravel embedded in a matrix of fine clay loam of depth varying from 2-6 feet. The uppermost layer of *cabook* is hard and scoriaceous, but the hardness rapidly decreases with depth, to a point at which it is possible to cut the material into bricks for building purposes. The lower horizons consist of very soft *cabook* containing large proportions of a yellowish white clayey material (chiefly hydrated aluminium oxides) in the interstices.

Can local cabook be called laterite ?

The term laterite was originally suggested by Buchanan (1807) as a name for a highly ferruginous deposit first observed by him in Malabar during his journey through the states of Mysore, Canara, and Malabar (1800-1). Because of the indefinite and often inexact uses of the term it is worth while to turn back to Buchanan's original description as quoted below :—

" What I have called indurated clay is one of the most valuable materials for building. It is diffused in immense masses without any appearance of stratification, and is placed over the granite that forms the basis of Malayala. It is full of cavities and pores and contains a very large quantity of iron in the form of red and yellow ochres. In the mass, while excluded from the air, it is so soft that any iron instrument readily cuts it and it is dug into square masses with a pick-axe and immediately cut into the shape wanted with a trowel or large knife. It very soon after becomes as hard as brick and resists the air and water much better than any bricks I have seen in India.

As it is usually cut into the form of bricks for building it is in several of the native dialects called brickstone. The most proper English name would be laterite, from ' lateritis, ' the appellation that may be given to it in science. "

The derivation of the word is from the Latin " later " meaning a brick and obviously relates to its use as a building material and not to its red colour.

Following Buchanan, the word laterite has been used by geologists and soil scientists all over the world.

In 1931 Fermor, Director of the Geological Survey of India, in his editorial introduction to the report on Buchanan's laterite of Malabar by Fox, (3) states :—

" Buchanan's original laterite consists mainly of what we should now call lithomargic laterite and even in part lateritic lithomarge, and that the rocks studied by Buchanan represent but a stage in the passage from granites and gneisses through kaolin or lithomarge, characterised by the presence of combined silica, to a rock consisting mainly of hydrated oxides of alumina and iron in which combined silica is characteristically absent. The latter portion of this process of weathering or change is now generally known as laterization, and the final product is known as laterite. From this point of view Buchanan's laterite is an intermediate form needing some qualifying adjective such as ' lithomargic.'

" If Dr. Fox were possessed of the zeal shown by some systematists who delight to upset established usage in favour of the strict application of the laws of priority, often with either annoying or amusing results, he would now propose that the term laterite should be restricted to the lithomargic rocks studied by Buchanan, and

that a completely new term should be adopted for the high level laterites of Deccan. Such a proposal would also necessitate the scrapping of the term laterization. However, Dr. Fox has shown a sense of proportion in recognising the facts of present usage, and it is clear from his paper that in future, whilst the term laterite can be applied in a comprehensive sense both to Buchanan's laterite overlying original acid rocks, namely granites and acid gneisses, and to the high level laterites of the Deccan overlying basic rocks, mainly basalts, yet when it is desirable to be more precise, we must regard the high level laterites of the Deccan as the finished products—the fully formed laterite—whilst Buchanan's laterite of the Malabar coast must in the main be regarded as lithomargic laterite, in so far as it has not become a more finished laterite. "

From the above description it is evident that the local *cabook* fits in with the material originally described as laterite and may rightly be called laterite.

Various views have been expressed as to the origin of laterite and the process of laterization, but a discussion of that subject is not appropriate in the present context.

Cabook and Associated Soils encountered in the Low Country Wet Zone.

In this region, and at elevations of up to 500 ft., *cabook* is quarried in different areas at various depths with an average of about 2 feet from the surface. In some areas the hard honeycomb laterite is seen protruding on the surface. There are other areas where the quarriable *cabook* layer is not very deep. However, these *cabook* occurrences are not very extensive and therefore soils developed solely on laterite are not found to a great extent.

But the majority of the soils encountered seem to have some connection with *cabook* either by their morphological appearance or by the presence of one or more of the constituents found in profiles containing *cabook*.

Deep, compact, gravelly soils, with colour variations, both within and between profiles, of red and pinkish red to reddish yellow and yellowish brown are of common occurrence. Ironstone gravel or quartz are generally associated with such soils. There are others with ironstone gravel that show no distinct colour horizons except for the surface layer which, in virgin soils especially, is brownish due to the admixture of humus. In still other soils pieces of hard honeycomb laterite may be present on the surface or in the profile.

Certain soils show the morphological characteristics of *cabook* but lack the cohesive properties of same and therefore are not quarried for building stones. These are less indurated and therefore softer than *cabook*. To what extent are the above soils laterite or lateritic ?

The presence in soils of one or more of the constituents found in a *cabook* quarry may be due to pedogenesis following the dissection of a true laterite profile or may be due to their formation *in situ*.

For example (*a*) Ironstone gravel, called "Boralu" in Sinhalese, may arise as a result of breakdown of hard honeycomb laterite crust or as a result of true laterite being exposed, transported to other sites and subsequently broken down or it may have been formed by the deposition of iron compounds on suitable nuclei, such as broken pieces of rock or quartz either in profile or on the surface of the soil, in areas of suitable moisture status.

(*b*) Hard honeycomb laterite boulders may be present due to the dissection of true laterite profile and subsequent transport of broken boulders. (It is likely that big boulders of hard honeycomb laterite encountered in many rubber-growing areas may have resulted in this manner). On the other hand, there is evidence of material similar to hard honeycomb laterite being formed as a result of the natural process of weathering of undecomposed pieces of rock on the surface of the soil.

Obviously these soils cannot be laterite. Nor can they be described as lateritic, for the origin of the said constituents may or may not be from a true laterite.

Soils with horizons resembling *cabook* morphologically but differing from it physically cannot be described as laterite or lateritic for the reason that they differ from the original description of laterite.

It is possible that these differences may be due to variations in the parent material or that the process of laterization is not complete. But until such time as the origin of laterite and the process of laterization is clearly understood, it may not be advisable to use the adjective "lateritic" in the description of these soils.

Other workers have tried to use the difficultly determined and often meaningless criteria of SiO_2/R_2O_3 or SiO_2/Al_2O_3 ratios of the clay fraction to determine whether or not a soil is a laterite or is lateritic.

Elastic use of the word laterite.

The above is typical of the confusion on a wide scale by pedological authorities in regard to the use of the word laterite and its derivatives.

Joachim (4), working on the composition of Ceylon laterites, found that analyses of laterite samples showed great variations in composition dependent on—

(*a*) The rock from which the sample was derived.

(*b*) The depth from which it was taken.

In view of this marked variation he states that the classification of soils into laterite, lateritic and non-lateritic on the basis of chemical criteria alone, *e.g.* SiO_2/R_2O_3 ratio of the clay fraction, is likely to be misleading. But being of the opinion that these ratios are a useful index for classifying soils on a broad basis he has classified a "Bata" jungle sandy loam, a "deniya" soil and an "owitta" soil, as being laterite or lateritic on the results of his analyses. (5)

SiO_2/R_2O_3 ratios are interesting and useful when considering large areas but do not distinguish sufficiently between agriculturally separate soils within such areas.

Kellogg (6) has suggested that laterite be defined as ferruginous material that hardens on exposure and the relics of such material. This definition would include the following forms of sesquioxide rich materials:

(1) Soft mottled clays that change irreversibly to hard pans and crusts when exposed.

(2) Cellular and mottled hard pans and crusts.

(3) Concretions.

(4) Consolidated concretions.

He has further suggested that a new term "Latosol" be adopted to comprehend all the zonal soils in tropical and equatorial regions having their dominant characteristics associated with low silica-sesquioxide ratios of clay fraction, low base-exchange capacities, low activities of the clay, low content of most primary minerals and few other properties. This name has been proposed at the categorical level of suborder.

Some of the Dutch workers in East Indies have gone even to the extent of calling anything red and rich in iron and alumina under rain forest conditions as lateritic. Van der Voorte (1950) (7) justifies the action of describing even red limestone soils which occur widely in the limestone area of South-Eastern Java as red lateritic limestone soils.

Suggested Soil Distinctions.

In view of what has been said it is evident that there is a need for criteria giving a reasonable number of soil distinctions in describing and classifying soils associated with laterite. We must therefore seek more specific criteria appropriate to detailed as opposed to wide-scale reconnaissance work. Preferably such distinctions should be real and reflected in agricultural variations.

Proper *cabook* soils are obviously one such distinction, with clear agricultural association, but may have to be distinguished from *cabook*-like soils which resemble *cabook* morphologically but differ from it physically. These are of greater agricultural value.

Proper *cabook* soils may also have to be distinguished from artificial *cabook* soils based on SiO_2/R_2O_3 or similar ratios.

Similarly other soils may be distinguished by an apparent association with true *cabook* subsequently broken up and/or transported. The presence of material for the most part mechanically derived from hardened *cabook* will affect the nutritional value of a soil.

Conclusion.

The whole subject seems to be very controversial. It appears safer to adhere to the original clear definition and to classify soils in terms of this definition rather than try to introduce criteria not in the original description.

This paper has been written in order to stimulate discussion on a controversial subject which needs clear thinking and a fresh outlook. This would also serve to emphasize the need for greater co-ordination between organizations engaged in similar work, so that some day it may be possible to produce a soil map of Ceylon.

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A NOTE ON THE "GROOMING" OF RUBBER TREES

By

C. A. de Silva

The correct procedure of carrying out the annual grooming of rubber trees which has been recommended within the last decade has not been clearly understood by a number of estate superintendents. In a few cases the type or time of grooming has been responsible for a high incidence of bark canker caused by Phytophthora. It is hoped that this note will clarify the many controversial points that have arisen in connection with this operation of estate sanitation.

The word "grooming" is specifically used, as opposed to scraping, to describe the operation of cleaning out lichens and mosses which develop on trees during the long periods of monsoonal wet weather.

This form of extraneous growth on the trunks of rubber trees is more common in damp and sheltered areas. These areas are obviously more susceptible to the incidence of wet weather diseases, especially if they are planted with clones which are susceptible to Phytophthora diseases.

Scraping produces cracks in the bark which in the wet season harbour undesirable fungous spores.

Advantages of Grooming.

(1) It helps in the collection of clean latex, especially during the dry periods when grooming prevents extraneous matter from falling off the bark into the cups.

(2) In wet weather the jelly-like decaying mosses can acidify the rain water and cause precoagulation on the cuts and in the cups.

(3) The groomed bark up to about a height of 6 to 7 feet from ground level retains less water during wet periods and helps in the early drying out of tapping panels.

(4) The retention of infecting spores, such as those of Phytophthora, is greatly reduced when the bark is clean and dry.

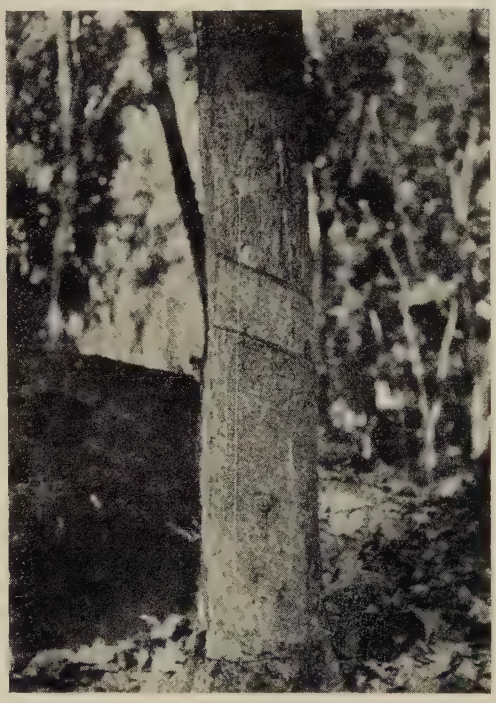
Time of Grooming.

Grooming should be carried out well within a dry period. The most suitable time will be during the wintering period, especially on estates where the annual wintering rest period is observed.

In certain extremely wet districts it is possible that two groomings a year are necessary. This second grooming can be done in September when a reliable period

METHODS OF GROOMING

Correct Grooming



Incorrect Grooming

of dry weather can be expected but may cause certain difficulties with labour since the operation would have to be carried out when the trees are in tapping.

Method of Grooming.

In order to avoid the incorrect methods of grooming, which really amount to taking off more than the very superficial corky layer together with the lichens and mosses, it is best not to use the type of metal scrapers favoured for Canker treatment.

A coconut husk of the correct shape and size for grooming can be made by shaving off a part of the inner fibre of the husk and bringing the hard outer covering to a fairly sharp edge; about a sixth part of a whole coconut husk would be sufficient for making one grooming implement.

In the dry weather the superficial layers of corky bark together with the lichens and mosses are so dried out that they begin to peel off naturally. It is then necessary only to groom these layers off up to a height of about 6 feet from ground level. The photographs show two trees which have been correctly and incorrectly groomed.

The danger of bark infection due to careless scraping, especially during wet weather periods, has been noticed on a number of estates which the writer was called upon to visit for heavy incidence of canker.

The use of the scraper, especially on seedling trees and certain clones with irregular bark may lead to a number of superficial wounds indicated by pin points of latex exudation on the scraped trunk, or by a considerable amount of latex drip down the stems from deeper bark injuries.

Special care should be taken when grooming renewed bark on the tapping panel. Injuries caused by careless grooming may lead to irregular callusing of renewed bark. These undesirable repercussions of incorrect grooming can be avoided with the minimum amount of supervision if a coconut husk is used instead of a metal scraper.

If the advantages of grooming are carefully explained to the tapper, he may be made to realize that this particular work of estate sanitation helps in the drying out of tapping panels and in preventing precoagulation in the field. He may then be favourably disposed to carry out this operation as a part of his tapping task.

PLANTING TOPICS

Mother Tree of Clone PB 86

Our readers will be interested in the photograph on the opposite page of the seedling mother tree or bud parent of clone PB 86 and some may even speculate as to the number of its vegetative progeny to be found in all countries where rubber is grown commercially.

This "old warrior" planted in (*c*) 1910 on Kajang Estate, Selangor, Malaya, is now the only remaining tree of the old stand in a replanting in "A" Division of the estate and may be seen close to the 18½ milestone on the main Kajang-Seramban road.

Its existence was seriously threatened a few years ago by a new cutting made to straighten out a curve in the road but fortunately an eleventh hour reprieve was obtained through the strenuous and unsparing efforts of the present Manager of Kajang Estate, Mr. J. C. Mathison.

The tree, originally known as Kajang 10, was only one of about a million mature trees in the district of Kajang originally selected by Major Henry Gough as bud parents and from which 618 clones were finally selected for trial on some 1,100 acres of jungle land cleared and planted during 1921-24 on the then newly opened Prang Besar (Malay=Great War) Estate.

The photograph was taken in the presence of the writer and of Mr. Mathison on 9th April, 1952.

The girth of this historic tree at 3 feet from the ground then measured 66 inches.

Clone PB 86 is the most popular clone in Ceylon. It is estimated that 70 to 80 per cent. of the areas replanted under the Rubber Replanting Subsidy Scheme from 1953 to 1957 have been planted with clone PB 86.

E. D. C. B.

QUESTION CORNER

Question.

Does the cultivation of cover crops result in competition for soil moisture?

Answer.

This question implies that moisture lost through transpiration of the foliage of the cover plants may deprive the rubber plant of soil moisture to some extent. This argument seems quite sound.

But why are cover crops cultivated?

They have been found to reduce soil erosion and surface run-off, and to increase the organic matter content of the soil which in turn will increase the water holding capacity of the soil. Therefore the answer to cut down moisture losses through transpiration is not to do away with cover crops.

According to work done in Ceylon by Joachim, a comparison of moisture content of soil under a clean weeded surface and under a cover of creeping legume, *Centrosema pubescens*, showed that for the first two years after establishment of the cover there was more moisture in the first six inches of the soil under the cover than in the corresponding region of the bare soil, but the reverse was true for soil below a depth of 6″. The greatest total moisture in the top 18″ was found under the bare soil. It was evident that more moisture was lost by transpiration from the cover plant than was conserved by the surface mulch it produced. However, during the second two years of the experiment the mulch under the cover plant developed to such an extent that eventually more moisture was found at all levels down to 24″, under the cover plant than under the bare surfaces.

If we may generalize from these findings it may be said that there can be competition for moisture during the early years of a plantation. But, thereafter an equilibrium will be established when the area under cover will, in fact, conserve moisture. The time taken for this equilibrium to be established will depend on several factors such as climatic conditions, type of soil, lie of land, etc.

In newly planted rubber areas, it would seem therefore that the top soil in the planting row will tend to be dry and that the reserves of water in the subsoil are likely to suffer depletion by lateral diffusion into the drying subsoil under the inter-row covered area. This will tend to make the rubber plants along the row susceptible to drought, up to the end of about the second year.

It is therefore very important to find ways and means of reducing evaporation losses through the bare soil along the planting row. This may be achieved by mulching, and it is a very strong argument in favour of mulching being carried out along the planting rows during the early years in the life of a plantation.

Question.

I have recently received complaints regarding rust in sheet rubber. Can the incorporation of paranitrophenol in latex be recommended or would it be better to dip the wet sheets in a solution of this chemical, to prevent this defect?

Answer.

Rust is a brownish deposit or thin film on sheets, which becomes visible as a powdery substance when the sheets are stretched or scratched with a blunt object. It is caused by the fermentation of the non-rubber constituents on the surface of the wet sheets due to development of bacteria, yeast or certain fungi.

The steps usually taken to eliminate this defect are designed to ensure:

(1) that the sheets are well washed during, and perhaps after, milling by dipping them for a short time in running water,

(2) that the dripping time is preferably not more than 1½—2 hours,

(3) that the wet sheets are inserted immediately after dripping into a hot smoke house or that at least a temperature of 120—130°F is obtained shortly after insertion,

(4) that there is sufficient ventilation in the smoke house.

Paranitrophenol can be quite effective for the prevention of rust and mould in smoked sheet, but its use for this purpose should not be necessary if the above precautions are taken. Further, the Labour Medical Officer does not approve of the use of paranitrophenol because of its toxicity by skin absorption or by ingestion or because of its skin irritating effects, and for these reasons this Institute does not recommend its use for that purpose.

As an alternative to paranitrophenol Antimucin WB may be used for the prevention of rust. The wet sheets, immediately after rolling, should be soaked in a 0.5% solution of this chemical for a period of about 10 minutes. Excellent results have been obtained in Sumatra with Antimucin for the prevention of rust and mould in smoked sheet.

RUBBER RESEARCH INSTITUTE OF CEYLON

Minutes of the 158th meeting of the Rubber Research Board held at 10 a.m., on Thursday, 30th October, 1958, in the Board Room of the Rubber Control Department, Eastern Bank Building, Fort, Colombo.

Present.—Mr. S. Pathmanathan (in the Chair), Mr. G. H. Carter, Dr. M. F. Chandraratne (Director of Agriculture), Mr. W. P. H. Dias, J.P., Mr. G. H. Dulling, Mr. V. T. G. Karunaratne, M.P., Mr. B. Mahadeva (Rubber Controller), Mr. H. E. Peries (Deputy Secretary to the Treasury), Senator Thomas Amarasuriya, O.B.E., Dr. E. D. C. Baptiste (Director) and Mr. C. D. de Fonseka (Administrative Secretary).

An apology for absence was received from Mr. L. C. de Mel.

1. Board :

Changes.—The Chairman welcomed Dr. M. F. Chandraratne (Director of Agriculture) and Mr. B. Mahadeva (Rubber Controller) on their return from abroad.

2. Minutes :

(*a*) *Confirmation.*—Draft minutes of the meeting held on 29th August, 1958, which had been circulated to members, were signed by the Chairman subject to a minor amendment.

(*b*) *Matters arising from the minutes :*

1. *Purchase of a sub-station.*—The Chairman reported that a few offers had been received in response to the enquiry addressed to Agency Houses regarding the purchase of a sub-station. The Director was asked to visit the estates concerned with the Visiting Agent to determine their suitability.

2. *London Advisory Committee.*—In accordance with a suggestion made by the Rubber Research Institute of Malaya, the contribution to the L.A.C. for 1959 was increased by £70.

3. Administrative Committee :

The recommendations made by the Administrative Committee at its meetings held on 30th September and 9th October 1958 were approved subject to certain amendments and the following decisions were arrived at on the basis of these recommendations.

(*a*) *Director's Report for 1st half year* 1958.—was approved.

(*b*) *Research Programme for* 1959.—The draft Research Programmes of all Departments were approved and the following comments were noted.

Botany Dept.—The Research Assistant who had recently resumed duties after the completion of his course of training abroad would be in charge of certain field trials.

Plant Breeding Section.—All the clones introduced from Brazil recently would be used in the breeding programme with the object of establishing clones resistant to Phytophthora and Oidium as well as to Dothidella.

Plant Pathology Dept.—Dr. A. Riggenbach, Plant Pathologist, would be on leave for the first five months of the year and the Assistant Plant Pathologist, Mr. O. S. Peries, would be in charge of the department during that period. Dr. Riggenbach had accepted re-engagement for a further period of 2 years followed by 4 months' leave.

Experiments would be conducted to compare the effectiveness of electrostatic dusting with that of normal dusting against Oidium.

Chemistry Dept.—Dr. K. F. Heinisch, (Dr. techn. sc., Dipl. Ing.) had accepted appointment as Chemist and was expected to assume duties in December 1958.

Smallholdings Dept.—The smallholdings Department's Office had been transferred to premises No. 267/3, Galle Road, Bambalapitiya, with effect from 1st October 1958.

(*c*) *Buildings.*—In view of the large building programme to be undertaken shortly, a committee consisting of Messrs. L. C. de Mel, W. P. H. Dias, V. T. G. Karunaratne, the Chairman and the Director had been appointed to consider tenders and other matters connected with the construction of buildings.

(*d*) *Draft Estate Estimates for* 1959.—The draft Estate Estimates for 1959 providing for a crop of 275,000 lbs. at a cost of 79.94 cents per lb. were approved.

(*e*) *Estimates of Capital Expenditure.*—The Committee had recommended the reduction of capital expenditure to be incurred in 1959 to Rs. 430,123/- as sufficient funds were not available to finance the whole of the proposed expenditure.

4. Building Committee :

The following decisions were made in accordance with the recommendations made by the Committee at its meeting held on 9th October 1958 :

(*a*) *Asst. Staff Grade II Bungalows.*—Build only one Assistant Staff Grade II bungalow instead of three as previously estimated for.

(*b*) *Plans of buildings to be constructed.*—Plans prepared by the Institute's architects for the following buildings were approved :

1. Estate Superintendent's bungalow.
2. Extension to Staff Club House.

5. Provident Fund Committee :

The recommendations made by the Committee at its meeting held on 3rd October 1958 were approved and it was noted that certain investments of the Institute would be earmarked as Provident Fund investments.

The Board also agreed with the Committee's view that the utilisation of Provident Fund moneys for the purpose of granting housing loans to the staff was not desirable as such moneys should be available in full to members for investment in order to provide a suitable income after retirement.

6. Sub-Committee appointed to consider the post of Works Inspector :

The Committee's recommendations regarding the appointment of a Works Inspector were considered and it was decided that Mr. D. H. Abeywickrema be appointed to the post.

7. Reports and Accounts :

(*a*) *Inventory Report for* 1957.—was approved.

(*b*) *Draft Estimates for* 1959.—The draft estimates for 1959 as amended in accordance with the recommendations of the Administrative Committee and providing for income and expenditure as follows were approved :

Estimated Income ...	...	...	Rs. 2,095,715
Estimated Expenditure—			
Recurrent ...	...	Rs. 2,008,439	
Capital ...	...	,, 430,123	,, 2,438,562
Estimated Excess of expenditure over income ...			Rs. 342,847

(*c*) *Supplementary vote.*—A supplementary vote was passed to cover the cost of a billiard table and accessories for the Staff Club.

8. Staff :

(*a*) *Assistant Plant Breeder.*—Agreed that Mr. D. M. Fernando be re-engaged as Assistant Plant Breeder for a further period of 4 years and 3 months with effect from 1st May 1959.

(*b*) *Assistant & Minor Staff changes.*—Changes in staff since the last meeting were reported and approved.

(*c*) *Loans to officers for purchase of transport.*—Loans given to two officers for the purchase of transport were reported and approved.

9. Publications :

The following publications were tabled :

(*a*) Annual Report of the Rubber Research Institute of Ceylon for 1957.
(*b*) Combined 1st & 2nd Quarterly Circulars for 1958.
(*c*) Advisory Circular No. 60—Sale of Budwood.
(*d*) Smallholdings Folder No. 4/A—Sulphur dusting of Smallholdings 1958/59.
(*e*) Smallholdings Folder No. 5—Manuring of Rubber.

10. Next meeting :

It was decided that the next meeting of the Board be held in Colombo at 10 a.m. on Wednesday 17th December 1958.

The meeting then terminated.

RUBBER RESEARCH INSTITUTE OF CEYLON

Minutes of the 159th meeting of the Rubber Research Board held at 10 a.m., on Wednesday, 17th December, 1958, in the Board Room of the Rubber Control Department, Eastern Bank Building, Fort, Colombo.

Present.—Mr. S. Pathmanathan (in the Chair), Mr. G. H. Carter, Mr. L. C. de Mel, Mr. W. P. H. Dias, J.P., Mr. G. H. Dulling, Mr. V. T. G. Karunaratne, M.P., Senator E. W. Kannangara, Dr. E. D. C. Baptiste (Director), and Mr. C. D. de Fonseka (Administrative Secretary).

Apologies for absence were received from Mr. B. Mahadeva (Rubber Controller), Dr. M. F. Chandraratne (Director of Agriculture), and Mr. H. E. Peries (Deputy Secretary to the Treasury).

1. Board :

(*a*) *The late Mr. F. H. Griffith.*—The Chairman referred to the recent death of Mr. F. H. Griffith who had served as a member and as Chairman of the Board for a number of years and a vote of condolence was passed in the usual manner.

(*b*) *Change in Membership.*—The Chairman welcomed Senator E. W. Kannangara, O.B.E., who had been nominated to serve on the Board in place of Senator Thomas Amarasuriya, O.B.E., for a period of three years with effect from 7th November, 1958, or for such period as he continues to be a member of the Senate, whichever period is the shorter.

2. Minutes :

(*a*) *Confirmation.*—Draft minutes of the meeting held on 30th October, 1958, which had been circulated to the members, were signed by the Chairman.

(*b*) *Matters arising from the minutes :*

(*i*) **Purchase of sub-station.**—The estates visited by the Committee were reported to be unsuitable and the Committee was asked to visit certain other estates and report to the Board.

(*ii*) **Research Assistant, Chemistry Department.**—Agreed that the scholarship period of Mr. M. Nadarajah, Research Assistant, be extended by four months until April 1959.

3. Administrative Committee :

The recommendations made by the Administrative Committee at its meeting held on 4th December 1958 were approved and the following decisions were arrived at on the basis of these recommendations :

(*a*) *Auditor General's Report for* 1957.—The report was approved and covering sanction was granted for excess expenditure on revenue and capital votes for 1957. Balances of unexpended capital votes were revoted for 1958.

(*b*) *Transport Contract for* 1959.—Mr. Abdul Hameed of Welipenna was awarded the transport contract for 1959 on the basis of his tender.

(*c*) *Estate Superintendent.*—Mr. L. Wijeyagunawardana, Estate Superintendent, was re-engaged for a further period of 3 years and 3 months or 4 years and 4 months at his option, with effect from 17th June 1959.

(*d*) *4 Asst. Staff bungalows Grade I.*—A contract for the construction of 4 Assistant Staff Grade I bungalows was awarded to Mr. G. E. W. Fernando.

4. Salaries Committee :

The recommendations made by the Committee at its meeting held on 12th November '58 in regard to O & M Officer's report on the salary structure of the Institute were approved and it was agreed that the report be implemented.

5. Reports and Accounts :

Receipts and Payments Account for the 3rd Quarter 1958.—was approved.

6. Staff :

(*a*) *Plant Pathologist.*—The Chairman reported that Dr. A. Riggenbach, Plant Pathologist, had left Ceylon on 4th December on end-of-contract leave.

(*b*) *Acting Soils Chemist.*—Agreed that Mr. A. J. Jeevaratnam, Assistant Soils Chemist, should function as Acting Soils Chemist until a Soils Chemist is appointed.

(*c*) *Assistant & Minor Staff Changes.*—Changes in staff since the last meeting were reported and approved.

7. London Advisory Committee :

Minutes of a meeting of the Agricultural Sub-Committee held on 30th June 1958 and of the 64th Meeting of the Committee were approved.

The comments regarding the use of certain antibiotic preparations in Malaya for yield stimulation were noted with interest.

8. Next meeting :

It was decided that the next meeting of the Board be held at 10 a.m., on Friday, 13th February, 1959.

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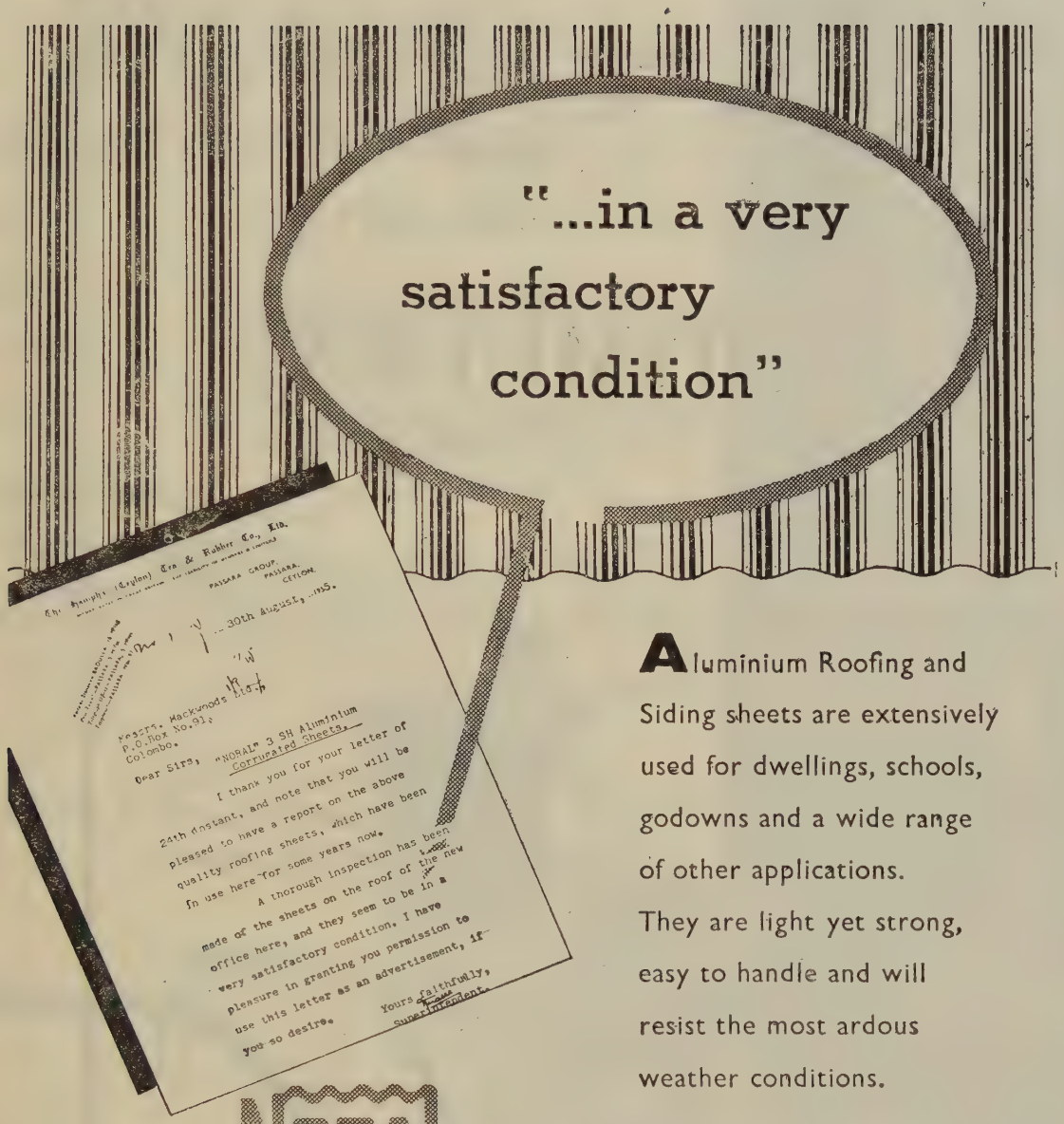
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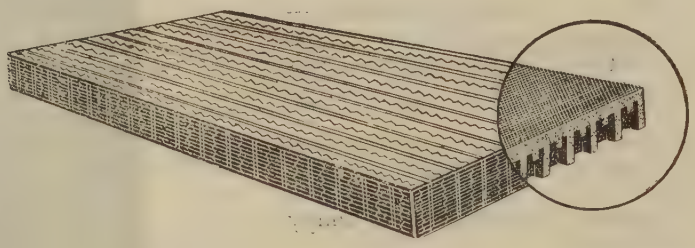

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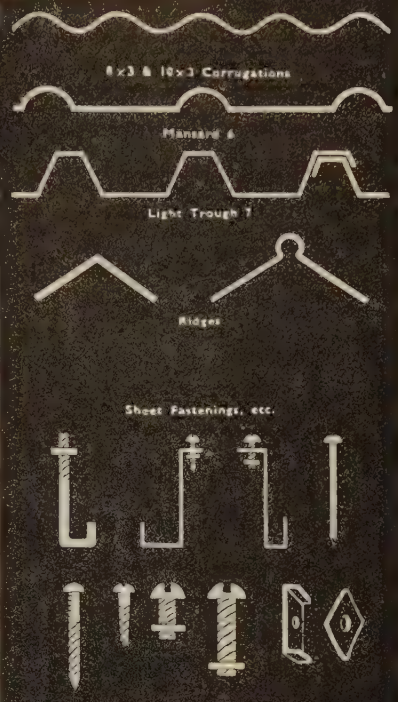

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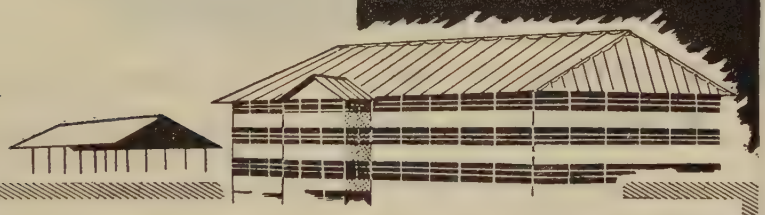

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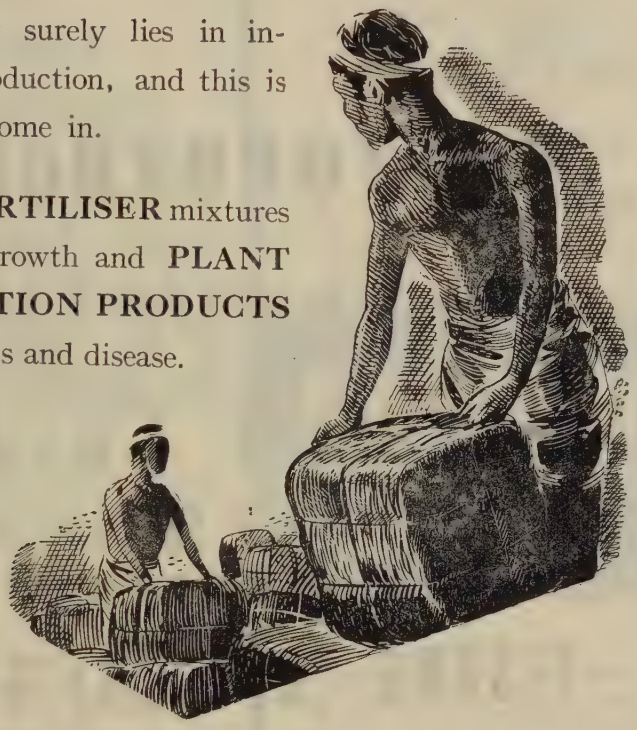

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